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February 13, 2002

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FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF THE SECRETARY

VIA MESSENGER

Mr. William Caton
Office of the Secretary
Federal Communications Commission
445 Twelfth Street, S.W.
TW-A325
Washington, D.C. 20554

01-278

Re: Submission in Proceedings RM-9375 and RM-10051

Dear Mr. Caton:

On February 12, 2002, we submitted comments electronically in ET Docket 01-278 on behalf of Hughes Network Systems, Inc. ("HNS"). However, we were unable to file electronically in the two companion proceedings, RM-9375 and RM-10051, because the system indicated that these proceedings were not open for submission to ECFS.

Therefore, we respectfully submit the following paper filing of HNS's comments in the above listed proceedings. Enclosed please find one (1) original and four (4) copies of the comments. Due to the size of the file, we are submitting to International Transcription Service, Inc. a CD-ROM containing the comments, instead of a diskette.

If you have any questions, please do not hesitate to call me at (202) 637-1056.

Respectfully submitted,

Elizabeth R. Park
of LATHAM & WATKINS

Enclosures

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BEFORE THE
FEDERAL COMMUNICATIONS COMMISSION
WASHINGTON, D.C. 20554

RECEIVED
FEB 13 2002
FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF THE SECRETARY

In the Matter of	)	
	)	
Review of Part 15 and Other Parts of the Commission's Rules	)	ET Docket 01-278
	)	RM-9375
	)	RM-10051
	)	

COMMENTS OF HUGHES NETWORK SYSTEMS, INC.

Hughes Network Systems, Inc., ("HNS") a subsidiary of Hughes Electronics Corporation, hereby comments on the Notice of Proposed Rule Making[1] in this proceeding. Among other things, the Commission has asked for comment on its proposal to establish standards for the manufacturing of radio receivers operating above 960 MHz, including radar detectors.

HNS is a leading manufacturer of C and Ku band earth station equipment, and the operator of many very small aperture terminal ("VSAT") satellite networks. HNS also is the operator of the two-way DIRECWAY high-speed, broadband service, the leading satellite-based broadband service, which operates in the Ku band. These systems provide critical business services and Internet connectivity to HNS' customers, both business and residential. HNS has a strong interest in this proceeding because one particular form of radio receivers, radar detectors, has caused debilitating interference to the VSAT systems of HNS and its customers throughout the United States.

In this proceeding, HNS urges the Commission to adopt rules that limit the radio frequency emissions of radar detectors. HNS also has concerns about intentional and

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[1] *Review of Part 15 and Other Parts of the Commission's Rules*, FCC 01-290 (rel. Oct. 15, 2001) ("*Notice*").

unintentional emissions from other Part 15 devices; however, HNS requests that those broader issues be addressed in a separate proceeding.

As detailed below, HNS and its VSAT customers, including state law enforcement agencies, stock brokerages, retail establishments, gas stations and automobile rental agencies, have suffered significant harm and incurred substantial costs from satellite communications outages caused by radar detector interference. The problem arises because these devices are used outdoors and often come within the line-of-sight of a VSAT terminal. Section 15.101(b) exempts receivers operating above 960 MHz, including radar detectors, from Part 15's technical requirements, including the emission limits of Section 15.109. Although radar detectors still are required to operate on a non-interference basis, it is not possible to enforce the existing Part 15 non-interference rules against users of radar detectors. Those devices are not under the control of HNS or its customers, and are typically used in moving vehicles that do not remain in one place for a long time. Effective relief can be obtained only by placing appropriate limits on the manufacture and sale of radar detectors.

I. TRENDS IN THE VSAT INDUSTRY

Due to advances in satellite technology in recent years, VSATs have become smaller and more affordable than ever before. As a result, VSATs appeal to a much wider range of users. In particular, VSATs that are one meter or smaller in diameter can be installed easily on roofs of small commercial buildings and homes, making these terminals suitable for broad deployment in densely populated residential and retail areas, as well as in rural areas. The broad deployment of VSATs has been further facilitated by recent Commission decisions that have preempted zoning regulations and restrictive covenants that previously limited VSAT installation.[2]

VSAT terminals are used by a wide variety of end users. For example, they are used for point-of-purchase credit card verification, and inventory and data management, by many financial service institutions and retail establishments, such as gas stations, department stores, auto parts stores, and fast food restaurants. They are used by government agencies to provide homeland security and disaster relief, in drug enforcement activities, and for law enforcement in general. The medical profession relies on VSATs for tele-medicine applications, such as reviewing medical histories and x-rays. And, most recently, VSATs have been deployed as a competitive alternative to the broadband offerings of cable systems and telephone companies.

The use of VSATs will continue to grow as VSATs play an increasingly more important role in carrying out the Congressional mandate in Section 706 of the Telecommunications Act of 1996 to facilitate the deployment of broadband services. Satellite-delivered broadband services are essential to providing affordable telecommunications services to rural communities and other underserved areas of America. Satellite systems provide nationwide coverage and offer high-quality, ubiquitous service as soon as the satellite system is launched and operational. As such, satellite systems offer instantaneous deployment to low-population density and low-income areas that may not be able to support terrestrial build-out.

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[2] 47 C.F.R. 1.4000. *See also, Preemption of Local Zoning Regulation of Satellite Earth Stations; Implementation of Section 207 of the Telecommunications Act of 1996 Restrictions on Over-the-Air Reception Devices: Television Broadcast Service and Multichannel Multipoint Distribution Service,* Report and Order, Memorandum Opinion and Order, 11 FCC Rcd 19276 (1996) ("*First OTARD Order*"); *Implementation of Section 207 of the Telecommunications Act of 1996; Restrictions on Over-the-Air Reception Devices: Television Broadcast, Multichannel Multipoint Distribution and Direct Broadcast Satellite Services,* Second Report and Order, 13 FCC Rcd 23874 (1998) ("*Second OTARD Order*"), *affirmed, Building Owners and Managers Ass'n Int'l v. FCC,* 254 F.3d 89 (D.C. Cir. 2001).

In short, a combination of factors--the development of smaller VSATs, the burgeoning demand for broadband connectivity, and the preemption of zoning restrictions--have resulted in a more widespread deployment of VSAT terminals, and have resulted in VSATs being deployed in many locations where they are particularly susceptible to interference from the operation of radar detectors that are used outdoors and in nearby motor vehicles.

II. Radar Detectors Cause Debilitating Interference to VSATs.

A. Nature of the Problem

VSAT services are provided today in the C and Ku bands, where the Fixed Satellite Service has a primary allocation. HNS and its customers operate pursuant to a variety of earth station licenses issued by the Commission, and therefore, have a legitimate expectation of protection from harmful interference from unlicensed devices, such as radar detectors.

A wide variety of HNS customers have experienced harmful interference from the operation of radar detectors. The types of customers include state law enforcement agencies, stock brokerages, retail establishments, gas stations, and automobile rental agencies. HNS has isolated radar detectors as the source of the interference after being called to various customer sites to investigate reported outages in the VSAT networks. Using a spectrum analyzer, in each case HNS' service agents were able to identify the source of the interference as radar detectors operating in vehicles parked nearby. When the radar detector was unplugged, the interference disappeared.

HNS' customers have suffered significant harm as a result of radar detector interference. By way of example, a customer operating a gas station uses the system to transmit credit card data to the credit card company for approval and billing of charges for customer purchases. Radar detectors in cars entering the gas station area can disable the credit card data transmission system. While the system is down, credit card transactions cannot be pre-approved and the gas station's customers cannot purchase gas. A more serious problem arises where the credit card has been pre-approved for a charge, but the system is disabled by interference after the gas has been pumped. When the interference disrupts the signal carrying the charge amount, the amount charged for the gas is lost and the gas station receives no payment for that transaction.

HNS itself is also directly affected by this interference. Radar detector interference has rendered unusable certain frequencies that HNS has leased from satellite operators. Even though HNS has vacated those frequencies to avoid the interference, it remains obligated to pay for capacity that effectively has been rendered unusable by radar detectors. And, vacating one frequency provides no assurance that the problem will not crop again in another part of the satellite spectrum. As noted below, there currently are no limits whatsoever on the frequency bands in which radar detectors can produce harmful radio frequency emissions. Thus, trying to move its carriers to avoid the radar detector problem costs HNS hundreds of thousands of dollars each year.

HNS has tested in its laboratories a number of the popular brands of radar detectors currently available on the market and has found that all of these devices cause harmful interference in the Ku band. Exhibit A attached hereto summarizes the results of these tests. The range of radiated emissions levels from these radar detectors at a distance of 3 meters is well over the current limit for emissions from unintentional radiators operating at frequencies above 960 MHz.[3]

[3] The current limit under 47 C.F.R. § 15.109 is 500 uV/meter at a distance of 3 meters for unintentional radiators above 960 MHz.

B. CURRENT REGULATIONS DO NOT ADEQUATELY PROTECT VSAT LICENSEES.

Section 15.109 of the Commission's rules requires that the field strength of radiated emissions from unintentional radiators operating at frequencies above 960 MHz be less than 500 uV/meter, measured at a distance of 3 meters.[4] However, Section 15.101(b) exempts receivers operating above 960 MHz, including radar detectors, from the technical requirements of Part 15, including these emission limits.[5] Although the users of radar detectors are subject to the Part 15 non-interference rules for receivers that are unintentional radiators,[6] this provision is effectively unenforceable. Because the radar detectors are installed in motor vehicles, the interfering operator typically is driving by, or is only temporarily stopped in the vicinity of the VSAT terminal. By the time the VSAT network user has experienced the interference event, the motor vehicle often has left the vicinity. Thus, it often is not possible to identify the operator of the vehicle causing the problem. Even when the operator of the radar detector causing the interference can be identified, there is nothing that can be done when a driver simply refuses to unplug the device.

Because the technical provisions of Part 15 do not govern the emission limits of radar detectors, manufacturers are not limited in any way in how they design or build these devices. In order to protect licensed satellite services, the Commission should adopt limits in this proceeding on radar detector interference into Ku band satellite services. As illustrated by the example above, VSAT users often cannot enforce Part 15 non-interference requirements against the users of radar detectors. Therefore, the only way to impose limits on the operation of radar detectors is to impose limits on the manufacture and sale of the devices themselves.

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[4] 47 C.F.R. § 15.109.

[5] 47 C.F.R. § 15.101(b).

[6] 47 C.F.R. § 15.5.

IV. THE COMMISSION SHOULD ESTABLISH A LOWER LIMIT ON RADIATED EMISSIONS IN THE KU BAND.

HNS urges the Commission to modify its rules and make radar detectors subject to the radiated emissions limits of Part 15 of the Commission's rules. Specifically, Section 15.101(b) should be modified to add radar detectors as a type of receiver to which Section 15.101(a) expressly applies, and the radiated emission limits of Section 15.109, in general, should apply to radar detectors. However, with respect to the Ku band (11.7-12.2 GHz), the current limit of 500 uV/meter at a distance of 3 meters for unintentional radiators operating above 960 MHz is insufficient to protect VSATs from harmful interference from radar detectors. Therefore, HNS recommends that the Commission, in the case of radar detectors, reduce the Section 15.109 radiated emissions limit in the Ku band to 30 uV/meter at a distance of 3 meters. This lower level is warranted by the fact that radar detectors operate outdoors and in close proximity to VSATs. The test results described in Exhibit A, attached hereto, demonstrate that emissions from radar detectors that are greater than this level result in harmful interference to licensed VSAT networks operating in the Ku band.

HNS also has concerns regarding the proliferation of many new types of Part 15 devices that are being considered, and the potential interference of these devices into satellite services in the C, Ku, Ka and V bands. HNS believes that it is appropriate for the Commission to address, in a separate proceeding, whether the current Part 15 limit of 500 uV/meter at a distance of 3 meters is sufficient to protect satellite services against harmful interference from Part 15 devices.

V. CONCLUSION

HNS and its VSAT customers have suffered, and will continue to suffer significant harm from interference into VSAT systems caused by radar detectors. This harmful disruption to their businesses and licensed operations will likely continue unless limits are placed on the manufacture and sale of these devices. For the reasons stated above, HNS requests that the Commission impose the technical requirements of Part 15 on radar detectors and that, for radar detectors, the Commission reduce the emissions limit in the 11.7-12.2 GHz band to 30 uV/meter at a distance of 3 meters.

Respectfully submitted,

HUGHES NETWORK SYSTEMS, INC.

By: ______________________

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Suite 1000
Washington, D.C. 20004
(202) 637-2200

February 12, 2002

CERTIFICATION OF PERSON RESPONSIBLE
FOR PREPARING ENGINEERING INFORMATION

I hereby certify that I am the technically qualified person responsible for preparation of the engineering information contained in the foregoing submission, that I am familiar with Parts 2 and 15 of the Commission's rules, that I have either prepared or reviewed the engineering information submitted in this pleading, and that it is complete and accurate to the best of my knowledge and belief.

Hughes Network Systems, Inc.

By: ______________________
Kanwaljit S. Sahai
Advisory Engineer

Dated: February 12, 2002

Exhibit A
Automobile Radar Detector Interference on Very Small Aperture Terminals (VSATs).

Radiated Emissions Test Results And Proposed Field Strength Limits for Radar Detectors

1. INTRODUCTION:

This report documents the results of electromagnetic compatibility tests performed on consumer type Radar Detectors to determine their potential for interference. The frequency band analyzed is the Fixed Satellite Service (FSS) Ku-Band Satellite downlink frequencies between 11.7 and 12.2 GHz.

Radiated emission evaluation measurements were performed on a Escort Cordless Solo, Cobra model 6050LE, Whistler model 1730 and Beltronics model 916 automobile radar detectors. Each hereafter will be referred to as the RDUT (radar detector under test).

The testing was performed at the Hughes Network Systems (HNS) Regulatory Compliance Laboratory in Germantown, MD. The HNS Laboratory has demonstrated and received FCC compliance to ANSI C63.4 in the frequency range of 9 KHz to 40 GHz.

Calculations were performed to determine the field strength limit necessary to protect HNS's VSAT system in the 11.7 – 12.2 GHz band. Attachment 5 includes three different types of carriers which were used in the calculations.

2. PURPOSE and SCOPE:

The purpose of this report is to document the radiated emissions of the subject Radar Detectors and propose a field strength limit upon all radar detectors.

The scope of this report is limited to the documentation of measured electric field strengths and frequencies of the subject Radar Detectors in the subject frequency bands of interest.

3. REFERENCE DOCUMENTS:

- ANSI C63.4 (1992) entitled "American National Standard for Methods of Measurement of Radio-Noise Emissions from low Voltage Electrical and Electronic Equipment in the Range of 9 KHz to 40 GHz", American National Standards Institute, institute of Electrical and Electronic Engineers, Inc. New York, NY 10017-2394, USA.

- Schaffer-Chase EMC Ltd., Chart 1 of series wall chart, 1998.

- Clayton R. Paul, Introduction to Electromagnetic Compatibility, Wiley Interscience, NY (1992).

4. TEST EQUIPMENT:

All testing was performed in conditions similar to installed conditions. Wiring was consistent with the manufacturer's specifications. Each Radar Detector Under Test (RDUT) was powered by a 12 VDC power supply except the Escort Cordless Solo which was powered by 3.0 volts via two internal 1.5 V AA battery cells. All RDUT operated in "highway" mode which exhibits the maximum receive sensitivity.

The measurement equipment used consists of:

- HP8593E spectrum analyzer (metrology A/N 26388); calibration due date: 11/04/02
- EMCO Horn antenna model 3115 with an operating range of 1-18GHz. (S/N 9701-5069); calibration due date: 03/05/02
- HP83712A synthesized CW generator (metrology A/N: 24989); calibration due date: 05/22/02
- Escort Solo radar detector (S/N 1AA1980242)
- Cobra Model 6050LE (S/N 106 001346)
- Whistler Model 1730 (S/N 17 031097)
- Beltronics Express Model 916 (S/N A089655)
- 50 ohm cable with N type termination.

5. SUMMARY OF TEST RESULTS:

Every one of the Radar Detectors randomly selected for radiated emissions testing was found to emit strong spurious signals into the first 100 MHz of the FSS Ku-Band receive allocation (11.7 – 12.2 GHz).

VSAT interference have been traced to these spurious signals to both in the field and in the laboratory environment. These respective measurements are as follows:

- **Escort Cordless Solo** radiated emissions versus frequency and antenna polarization are shown below in Table 1. The data shows an incursion of 116 MHz into the FSS Ku-Band receive allocation, more than one-fifth the allocated bandwidth.

The field intensity at 3m distance after doing the unit of measure conversions is shown in Table 1. The spectrum analyzer plots can be found in attachment 1 on page 12.

Frequency (GHz)	E_Horiztal (V/m)	E_Vertical (V/m)
11.573	N/A	0.0192745835
11.585	N/A	0.0163111658
11.753	N/A	0.0142884461
11.809	N/A	0.0163299555
11.816	N/A	0.01778218
11.478	0.0209645238	N/A
11.487	0.0199749179	N/A
11.496	0.0187708959	N/A
11.503	0.0195202332	N/A
11.506	0.024265263	N/A
11.527	0.0186202283	N/A
11.532	0.087277241	N/A
11.622	0.0206768798	N/A
[redacted]		

Table 1.
Horizontal and vertical electric field intensity measured at the feedhorn in the 11.0 GHz to 12.0 GHz range.

- **Cobra Model 6050LE** radiated emissions versus frequency and antenna polarization are shown below in Table 2. The data shows an incursion of 113 MHz into the FSS Ku-Band receive allocation, more than one-fifth the allocated bandwidth.

The field intensity at 3m distance after doing the unit of measure conversions is shown in Table 2. The spectrum analyzer plots can be found in attachment 2 on page 13.

	COBRA 6050LE	
Frequency (Ghz)	**E_Horizontal (v/m)**	**E_ Vertical (v/m)**
11.468	N/A	0.065765784
11.453	0.026061535	N/A
11.505	0.021281390	N/A
11.513	N/A	0.037068072
11.550	0.017844320	N/A
11.595	0.037196322	0.045603692
11.618	N/A	0.030974193
11.663	0.036770539	0.048250298
11.678	0.036728230	N/A
11.685	N/A	0.010939564

[redacted]

Table 2.
Horizontal and vertical electric field intensity measured at the feedhorn in the 11.0 GHz to 12.0 GHz range.

- **Whistler Model 1730** radiated emissions versus frequency and antenna polarization are shown below in Table 2. The data shows an incursion of 105 Mhz into the FSS Ku-Band receive allocation, more than one-fifth the allocated bandwidth.

The field intensity at 3m distance after doing the unit of measure conversions is shown in Table 3. The spectrum analyzer plots can be found in attachment 3 on page 14.

	Whistler Model 1730	
Frequency (Ghz)	**E_Horizontal (v/m)**	**E_ Vertical (v/m)**
11.453	0.012882496	N/A
11.46	N/A	0.118168031
11.483	0.005242036	N/A
11.543	N/A	0.112979591
11.550	0.010185914	0.045603692
11.565	0.005058247	0.010939564
11.58	N/A	0.108767714
11.625	0.01001152	0.030974193
11.625	N/A	0.091727594
11.663	0.02128139	0.000258821
11.685	0.020989399	N/A
11.685	N/A	0.062301715
[redacted]		

Table 3

Horizontal and vertical electric field intensity measured at the feedhorn in the 11.0 GHz to 12.0 GHz range.

- **Beltronics Express 916** radiated emissions versus frequency and antenna polarization are shown below in Table 4. The data shows an incursion of 100 Mhz into the FSS Ku-Band receive allocation, one-fifth the allocated bandwidth.

The field intensity at 3m distance after doing the unit of measure conversions is shown in Table 4. The spectrum analyzer plots can be found in attachment 4 on page 15.

	Beltronics Model 916	
Frequency (Ghz)	**E_Horizontal (v/m)**	**E_ Vertical (v/m)**
11.205	0.009099133	N/A
11.228	0.005081594	N/A
11.243	N/A	0.011363183
11.303	N/A	0.033227679
11.310	0.006531306	N/A
11.340	0.004492623	N/A
11.363	N/A	0.019588447
11.370	0.006223003	N/A
11.468	N/A	0.021305906
11.535	0.005767665	N/A
11.580	0.004446313	N/A
11.603	N/A	0.008679606
11.618	0.004539416	N/A
11.640	0.004581419	N/A
11.655	N/A	0.010411181
11.663	0.004726068	N/A
11.685	N/A	0.009527962

[redacted]

Table 4

Horizontal and vertical electric field intensity measured at the feedhorn in the 11.0 GHz to 12.0 GHz range

6. CALIBRATION, TEST CONFIGURATION & UNIT OF MEASURE CONVERSION FORMULA:

The 50 ohm cable was first calibrated to determine the cable loss from 1.0 GHz to 12.0 GHz. One end of the cable to connected to the HP83712A generator and the other end to the HP8593E spectrum analyzer. The generator was set to provide a –60dBm signal and the signal strength observed on the spectrum analyzer. The difference between the input power and the spectrum analyzer reading is the cable loss.

Next, the RDUT is set on a table approximately 80cm above a ground plane and the radiation from the detector measured using the EMCO horn antenna. The antenna is set on a tripod also at a height of approximately 80cm from ground level. The antenna is set at 3m distance from the RDUT. The test setup is shown in Figure 1 below.

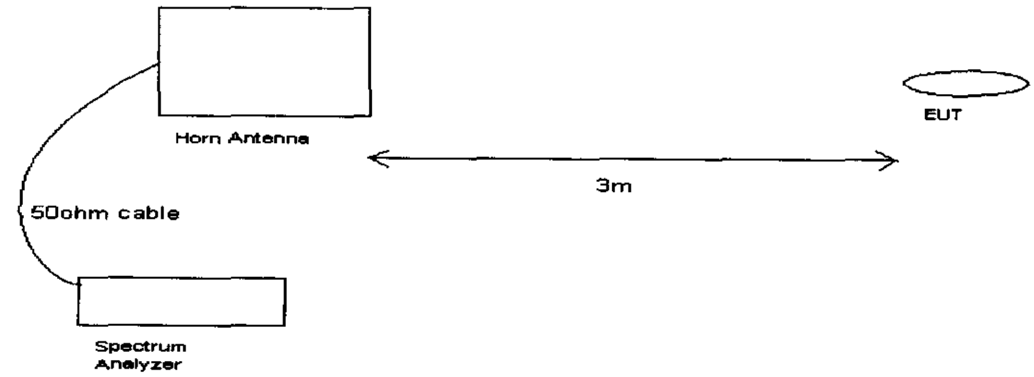


Figure 1. Test Setup

The RDUT was turned to the ON position and the spectrum analyzer was tuned to display the radiation from the RDUT in the range of 11GHz and 12GHz. The spectrum analyzer was also set on max hold to ensure that all radiation in the range is measured. This measurement was carried out for both the horizontal and vertical polarization.

To ensure that the radiation picked up is from the RDUT, the experiment was repeated with the RDUT removed from the test setup.

The cable loss and antenna factor as a function of frequency is shown below in Table 5.

Frequency (Ghz)	Cable Loss (dB)	Horn Antenna Factor (vertical)	Horn Antenna Factor (horizontal)
1.00	2.3	25.2	26.2
1.50	3.2	26.6	27.4
2.00	3.6	29.0	29.4
2.50	4.5	30.3	30.5
3.00	4.9	31.6	32.1
3.50	7.1	32.7	33.1
4.00	5.3	34.1	34.1
4.50	6.3	33.8	34.7
5.00	5.9	35.0	35.8
5.50	5.7	35.7	36.6
6.00	6.9	36.1	36.8
6.50	6.7	36.2	37.1
7.00	6.2	37.1	37.9
7.50	5.6	37.3	39.0
8.00	6.7	38.1	39.0
8.50	6.8	38.5	39.3
9.00	6.8	38.9	40.2
9.50	7.5	39.2	40.4
10.00	7.4	39.5	40.4
10.50	7.1	39.8	40.5
11.00	7.4	40.0	40.9
11.25	7.8		
11.50	7.7	40.4	40.7
11.75	7.3		
12.00	8.5	40.7	40.6

The following calculations were made using the collected data.

1) Converting the data measured in dBm to dBµV

$$V(dB\mu V) = 90 + 10\log(Z) + P_{in\ dBm}$$

Z = characteristic impedance of the cable
P = measured data in dBm

2) Calculating the incident electric field E, on the antenna

$$E(dB\mu V/m) = AF(dB) + V_{SA}(dB\mu V) + \text{Cable Loss (dB)}$$

AF = antenna factor
V_{SA} = spectrum analyzer reading

7. Proposed Field Strength Limits for Radar Detectors

HNS currently provides several types of carriers that can be classified as narrowband and wideband carriers. HNS currently provides DirecWay domestic broadband service in the Ku band and would like to propose a limit on radar detector emissions in the FSS (space-earth) Ku band (11.7 – 12.2 GHz).

In Attachment 5, three calculations in the Ku band are made. The common assumptions are an off-axis gain of the earth station toward the interference source of –10 dBi, an antenna efficiency of 65%, range of the satellite from the earth, an operating frequency of 11.95 GHz, and a carrier to interference level of 20 dB.

Item 1) assumes in the calculations, a satellite downlink power (EIRP) of 46 dBW in the coverage area and an earth station diameter of 74 cm. The received power carrier at the receiver for a wide-band DirecWay service is computed to be –121 dBW. Using a carrier to interference level of at least 20 dB, the interfering signal has a value of –141 dBW. This value is converted into an electric field strength, which is 720 µV/m. Therefore, the interfering source must not exceed 720 µV/m.

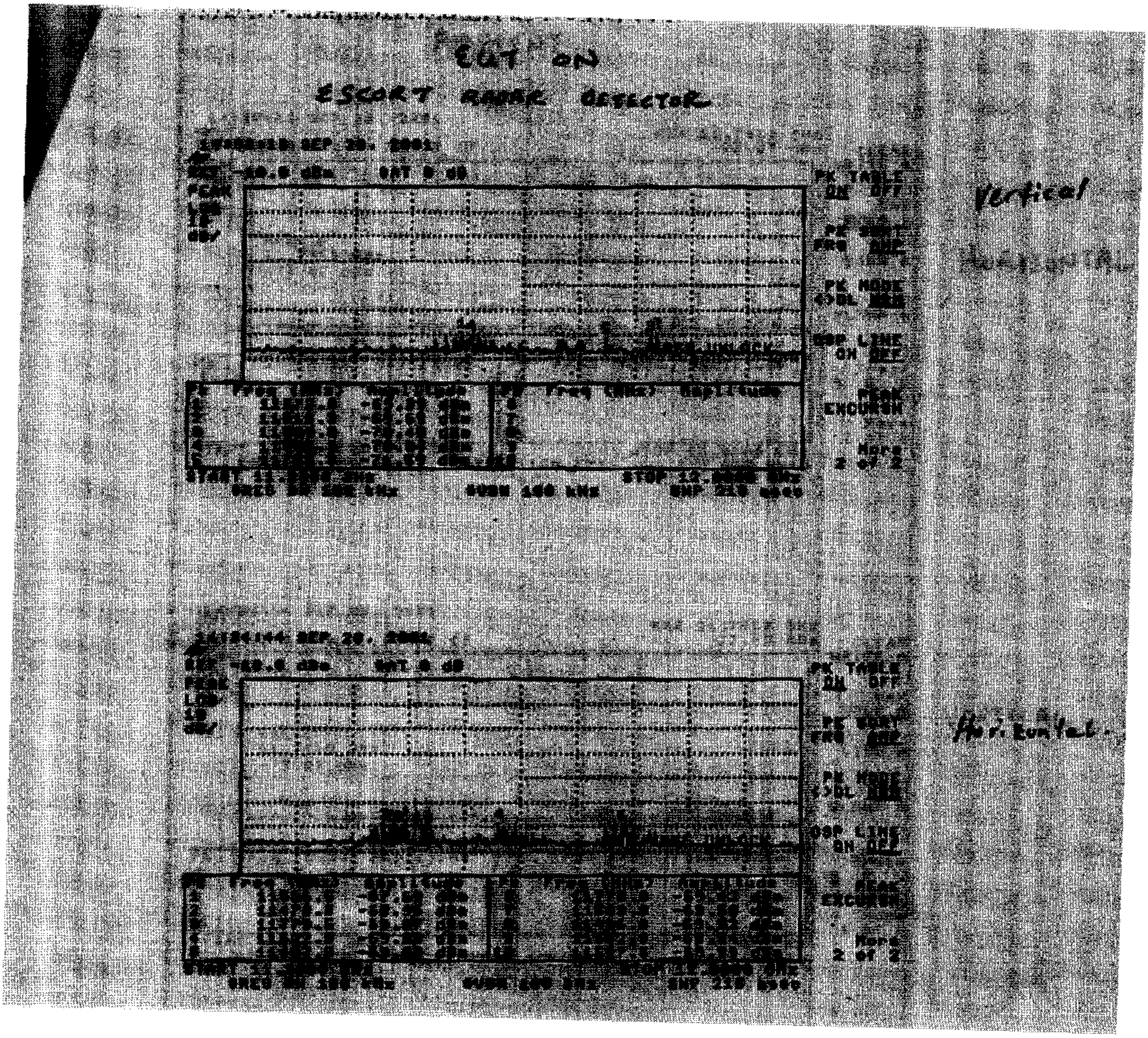
Item 2) calculates the tolerable field strength of a part 15 device for a narrow band two-way DirecWay service. The assumptions are the blanket licensing limit of 6 dBW/4kHz at the beam peak using a 1 m antenna, operating at the –3 dB contour from the beam peak. The data rate of the carrier equals 128 kbps, with a QPSK modulation and a signal bandwidth of 153.6 kHz. This narrow-band carrier can tolerate an interference level no greater than 42.7 µV/m.

Item 3) makes the same calculation as in Item 2), for a carrier using a data rate of 512 kbps, BPSK modulation, and a bandwidth of 1229 kHz. This narrow-band carrier can tolerate an interference level no greater than 120.8 µV/m.

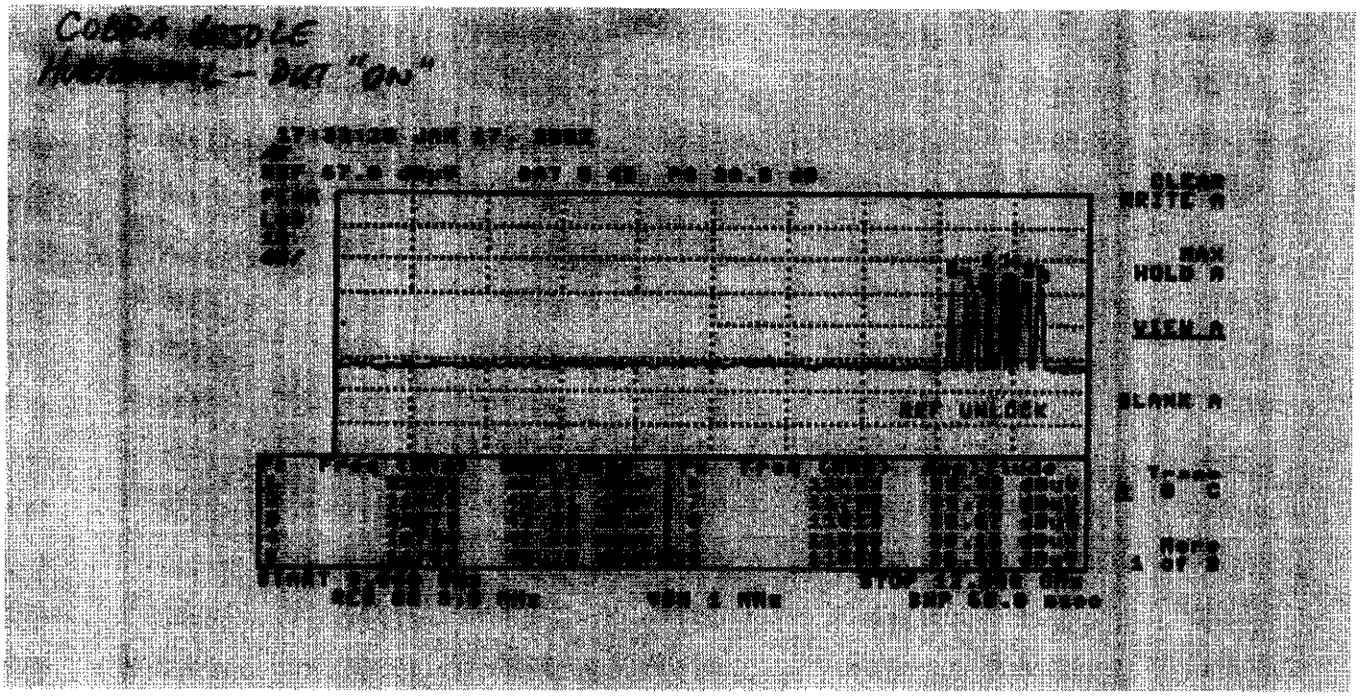
The three calculations show that the type of carrier used drives the interference level, in which a VSAT network can sustain. Carriers even more narrow than the worst-case calculation presented exist and are used by satellite operators. For a 64 kbps carrier occupying a 40 kHz bandwidth, the tolerable electric field strength of an interfering source can be as low as 30 μV/m in the 11.7 – 12.2 GHz band.

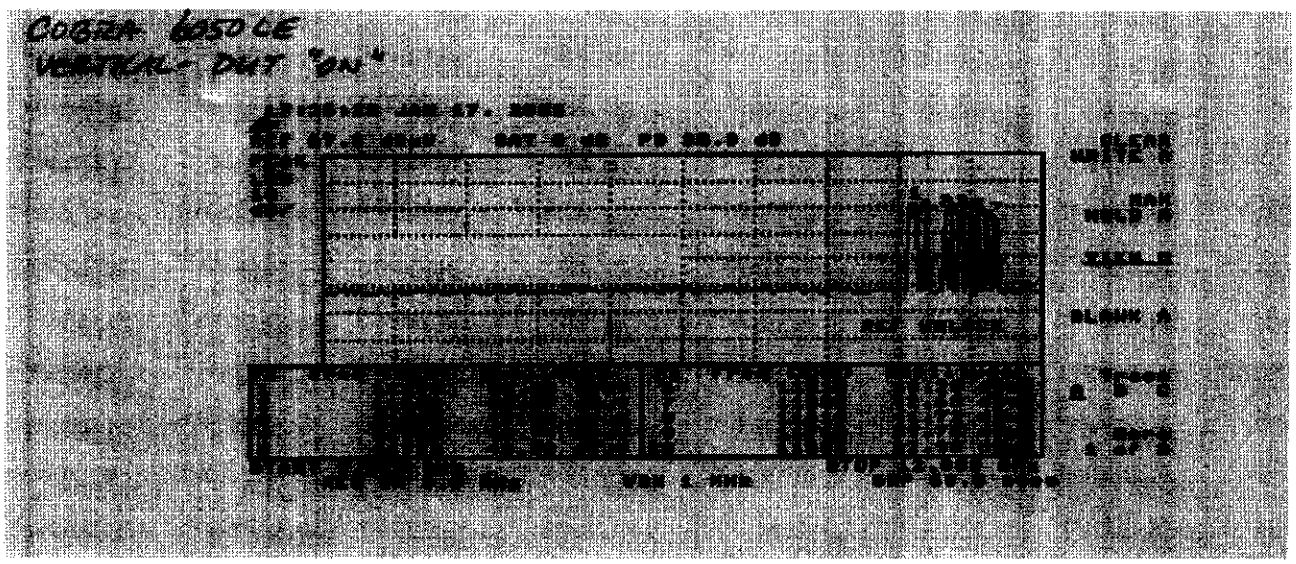
HUGHES NETWORK SYSTEMS

Attachment 1



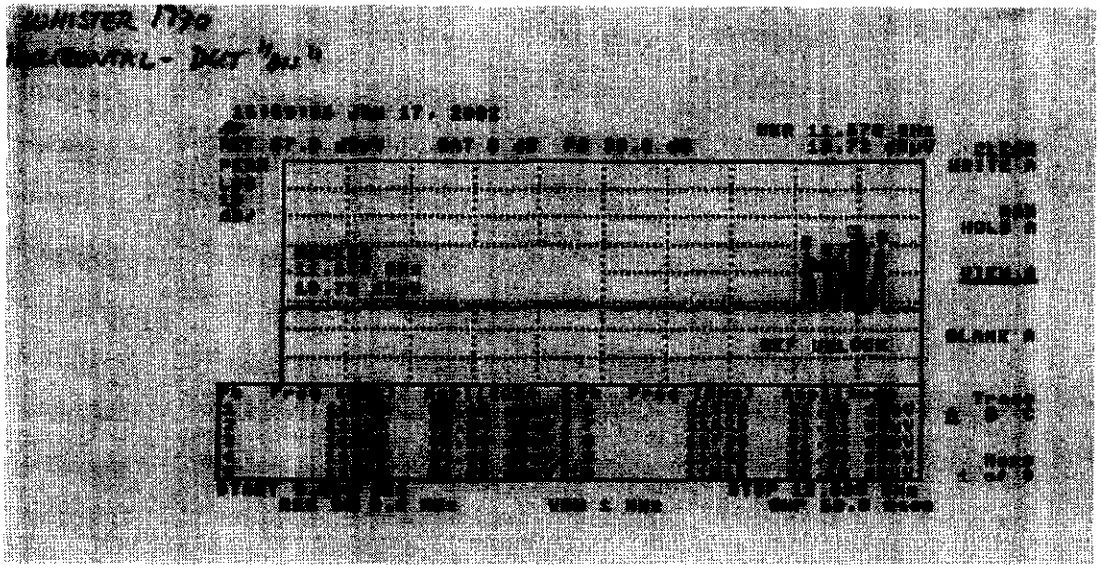
Attachment 2

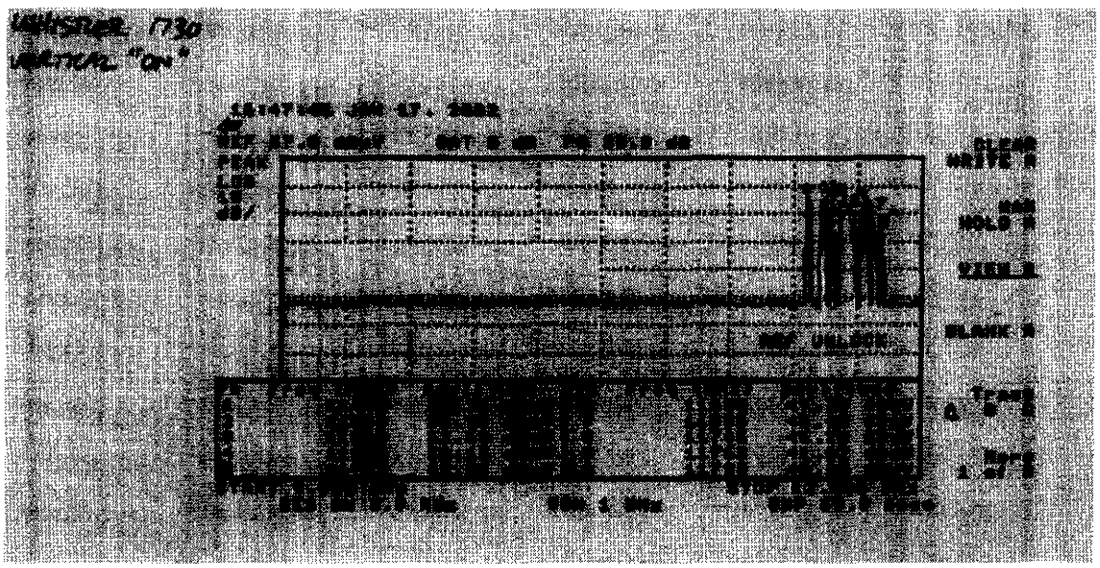




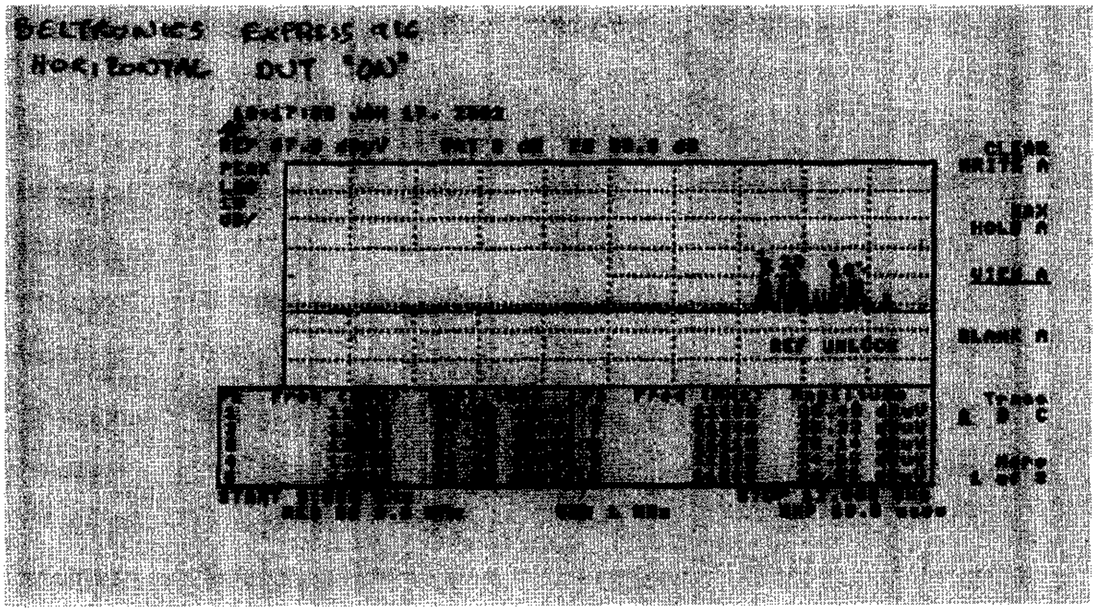
HUGHES
NETWORK SYSTEMS

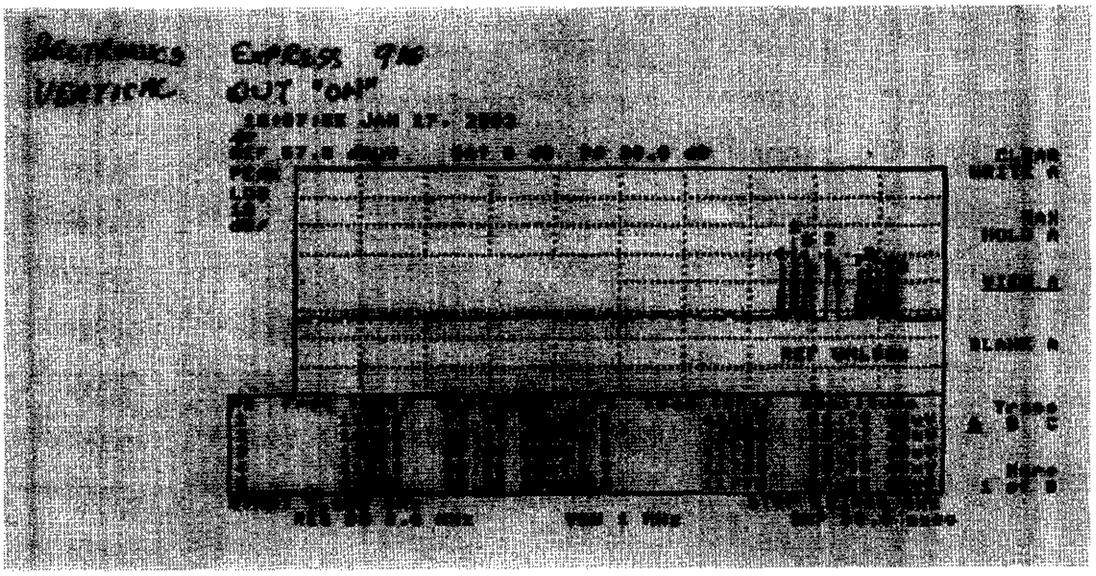
Attachment 3





Attachment 4





NETWORK SYSTEMS

Attachment 5

Field Strength Calculations

Compute the electric field strength from an interference source, assumed to be at a distance of 3 m, for a) a DirecWay two-way service using a wide-band carrier and b) DirecWay two-way service using a receive narrow-band carrier.

Assumptions:

$Goa := -10$ ... Off-Axis gain of earth station toward the interference source (dBi)

$n := 0.65$ ... antenna efficiency (%)

$S := 35788$ ... Range of satellite (km)

$freq := 11.95$ ... operating frequency (Hz)

$CI := 20$ ... carrier to interference level (dB)

$$lamda := \frac{3 \cdot 10^8}{freq \cdot 10^9}$$ ... wavelength (m)

$lamda = 0.025$

1) For a wide-band forward carrier (2-way enterprise DirecWay service).

$EIRP := 46$ ... Satellite downlink power (dBW)

$D := 0.74$ ... Earth Station Diameter (m)

$L := 20\log(S) + 20\log(freq) + 92.45$ ... Path Loss (dB)

$L = 205.072$

$Gr := 20\log(D) + 20\log(freq) + 10\log(n) + 20.4$ ... Antenna Gain (dB)

$Gr = 37.461$

$$G\_1m2 := 10\log\left(\frac{4 \cdot \pi}{lamda^2}\right)$$ ... Gain of 1m^2 antenna (dBi)

$G\_1m2 = 42.997$

$C := EIRP - L + Gr$ ... Power Flux Density (dBW)

$C = -121.611$

Assume a C/I of at least 20 dB, then

$I := C - CI$ ... interfering signal (dBW)

$I = -141.611$

$pfd\_i := I - Goa + G\_1m2$ ... pfd of interferer in dBW/m2

$pfd\_i = -88.614$

$$E\_i := \sqrt{120 \cdot \pi \cdot 10^{\frac{pfd\_i}{10}}}$$ ... interfering signal in V/m

[redacted]

2) For a narrow-band forward carrier (2-way enterprise DirecWay service).

Assumptions: the blanket licensing limit of 6 dBW/4kHz at the beam peak and using a 1 m antenna at -3 dB contour from the beam peak. Data rate equals 128 kbps with QPSK modulation and a bandwidth of 153.6 kHz.

$D := 1$ ... earth station diameter (m)

$Gr := 20\log(D) + 20\log(freq) + 10\log(n) + 20.4$ ... Antenna Gain (dB)

$Gr = 40.076$

$EIRP := 6 - 3 + 10\log\left(\frac{153.6}{4}\right)$ ... Satellite downlink power dBW)

$C := EIRP - L + Gr$ ... carrier power at the receiver (dBW)

$C = -146.152$

Assume a C/I of at least 20 dB, then

$I2 := C - CI$ ... interfering signal (dBW)

$I2 = -166.152$

$pfd\_i2 := I2 - Goa + G\_1m2$ ... pfd of interferer in dBW/m2

$pfd\_i2 = -113.155$

$E\_i := \sqrt{120\pi \cdot 10^{\frac{pfd\_i2}{10}}}$ ... interfering signal in V/m

[redacted]

3) For a narrow-band forward carrier (2-way enterprise DirecWay service).

Assumptions: the blanket licensing limit of 6 dBW/4kHz at the beam peak and using a 1 m antenna at -3 dB contour from the beam peak. Data rate equals 512 kbps with BPSK modulation and a bandwidth of 1229 kHz.

$D := 1$ ... earth station diameter (m)

$Gr := 20\log(D) + 20\log(freq) + 10\log(n) + 20.4$ ... Antenna Gain (dB)

$Gr = 40.076$

$EIRP := 6 - 3 + 10\log\left(\frac{1229}{4}\right)$ ... Satellite downlink power dBW)

$C := EIRP - L + Gr$ ... carrier power at the receiver (dBW)

$C = -137.121$

Assume a C/I of at least 20 dB, then

$I2 := C - CI$ ... interfering signal (dBW)

$I2 = -157.121$

$pfd\_i2 := I2 - Goa + G\_1m2$ ... pfd of interferer in dBW/m2

$pfd\_i2 = -104.124$

$E\_i := \sqrt{120\pi \cdot 10^{\frac{pfd\_i2}{10}}}$ ... interfering signal in V/m

[redacted]